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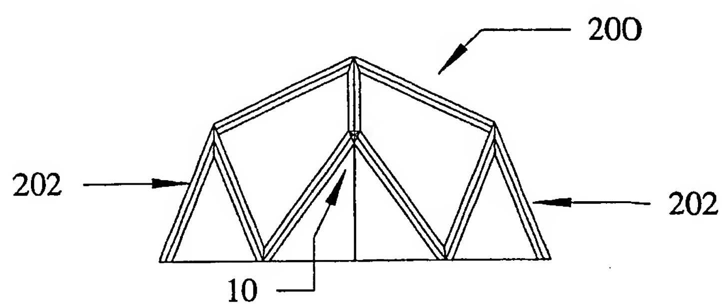
(54) Title: INFLATABLE STRUCTURE



(57) Abstract: This invention comprises of an inflatable structure that is constructed by combining polyhedron structural elements to form more complex geodesic structures. The structural elements are constructed out of straight inflatable tubes, in which the warp of the polyester reinforced fabric is aligned with the principal tube axis, giving it high resistance to bending. The complementary leg ends are connected at the vertices with connectors that comprises a slider and track formation, fixed along the axial angle at the end of each leg. Each leg end is shaped along the natural complimentary lines along the intersecting surfaces of the adjacent structural element. Once assembled in combination with a fabric cover and groundsheet, the tent is stable and completely freestanding.

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Description

Title: Inflatable structure

This invention relates to an inflatable structure.

The applicant is the patentee in respect of SA patent no 97/ 5569 - Inflatable tent frame - which describes a frame comprising at least three tubular legs each constituting a separately sealed chamber that is capable of being inflated with a fluid such as air or gas to constitute a frame structure for a tent or canopy.

Conventionally, inflatable structures such as inflatable boats, inflatable life rafts and the like are manufactured from airtight fabrics. These fabrics conventionally consist of a polyvinyl chloride (PVC) fabric reinforced with woven polyester. The fabric is cut and welded, either with the use of heat welding or with adhesives, to obtain the desired shapes.

However, tubes that are relatively long and narrow tend to distort, particularly if they are unsupported.

This kind of problem normally does not arise with inflatable water craft since these craft utilise relatively short, large diameter tubes and normally include rigid or semi-rigid structures to which the tubes are attached.

In the known inflatable tent technology it is very difficult to construct a frame that is fully free standing, unsupported by anchors and anchor ropes. Stability is normally achieved by utilising relatively large diameter tubes combined with an anchoring system, making the tent relatively heavy and expensive, limiting the application potential to relative small-specialised market sectors.

Frame structures as typically utilised in a tent or canopy, utilise structural intersections that are typically too complex and difficult to manufacture with the current state of art in inflatable tube manufacturing.

In conventional tent construction where the frame is constructed out of solid structural elements such as metal tubing or spring steel rods, a fare amount of labour and knowledge and time is needed to construct the tent. These tents, even in its simplest form still comprises out of different parts that needs assembly.

It is an object of this invention to provide tubular structural elements that address these deficiencies and to provide structures that utilise such structural elements.

Disclosure of the invention

According to this invention an inflatable structural unit comprises at least three inflatable tubes arranged in the form of a polyhedron.

In its simplest form, the structural unitAeneid comprises three inflatable tubes arranged in the form of a tetrahedron. In this arrangement, the three tubes are co-extensive with three edges of an imaginary tetrahedron.

In this form of the invention, the structural element comprises three legs that radiate from a point of interconnection to define an inverted, Y-shaped element, the arms of the Y constituting support legs and the stem of the Y being angled relatively to the legs to complete the tetrahedral shape of the support unit and defining an apical leg that, in use in a structure will constitute a support beam.

The inflatable tubes used in the support unit may be adapted to extend substantially straight under inflation pressure to obtain a conventional, straight-sided tetrahedron.

Alternatively, the tubes may be adapted to curve under inflation pressure to provide a more dome-shaped tetrahedron.

In tubes made of polyester reinforced PVC, the tubes may be adapted to extend substantially straight by aligning the warp of the polyester reinforced fabric with the principal tube axis. A tube made in such a manner will have a high resistance to bending.

To permit curvature of the tubes and to obtain varying degrees of curvature, the polyester reinforcing fabric may be arranged on the bias (with the warp at an angle to the tube axis) to a greater or lesser degree, depending on the desired curvature.

Being polyhedral, the structural element of the invention will yield, in combination with similar structural elements, a variety of geodesic structures. In such structures, the apical legs of the structural elements may be secured to the apical legs of adjacent, similar structural elements. In the same way the support legs of the structural elements may be secured to the support legs of adjacent, similar structural elements.

The apical leg of each structural element may be provided with mating connector formations to permit easy connection and disconnection to the apical legs of adjacent structural elements. In the same way the support legs of each structural element may be provided with mating connector formations to permit easy connection and disconnection to the support legs of adjacent structural elements.

In the preferred form of the invention, the connector constitutes the mating track and slider formations that can be inter engaged with one another to connect the structural elements together.

The tube ends of each structural element is geometrically shaped along the natural complimentary lines along the intersecting surfaces of the adjacent structural element. The connectors are fixed along their relative axial angles.

Connecting adjacent structural elements in this manner is simple yet it results in a very strong and supportive joint, utilising the inherent strength of the inflatable tube.

Structural elements connected together into a composite structure in this way form a very stable inflated structure.

Brief description of the drawings

In the drawings:

Figure 1 is a diagrammatic isometric view of a tetrahedral structural element according to this invention;

Figure 2 is a diagrammatic plan view of a simple inflatable structure made up of four of the structural elements of Figure 1;

Figure 3 is a diagrammatic end elevation of the structure of Figure 2;

Figure 4 is a diagrammatic plan view on the point of connection of the structural elements in the structure of Figures 2 and 3;

Figure 5 is a diagrammatic sectional side elevation illustrating a novel lighting arrangement for structures according to the invention:

Figures 6,7 and 8 are diagrammatic plan view, end elevation and side elevation respectively of a structure that combines the structural element of Figure 1 with a number of similar and dissimilar units to provide a more complex geodesic dome structure than that illustrated in Figures 2 and 3.

Description of embodiments of the invention

The inflatable structure of the invention is more of a construction system than a simple structure. The system relies on the use of an inflatable polyhedral structural element as its basic unit of construction. By combining such a structural element with similar structural elements or with similarly polyhedral structural elements, a large variety of structures can be created as will be illustrated below.

The structural element 10 illustrated in Figure 1 has an essentially tetrahedral shape. A tetrahedron, being a polyhedron with four triangular sides, the structural element is made of three inflatable relatively narrow tubes 10.2, 10.2, 10.3, each lying on an edge of the tetrahedron. Three of the triangular sides of the tetrahedron are constituted by the triangular planes included between the three legs and the fourth triangular side is constituted by the plane defined by the free ends of the legs.

Seen differently, the structural element constitutes an inverted Y shaped support element.

The legs 10.1 and 10.2 lie on the inverted arms of the Y and constitute support legs. The remaining leg 10.3 defines the stem of the Y, which is angled relatively to the legs 10.1, 10.2 to define a support beam in structures to be erected with the use of the structural element 10.

The tubes making up the legs 10.1, 10.2, 10.3 of the structural support element are made from airtight PVC fabric reinforced with woven polyester.

The woven polyester reinforcing fabric is arranged with the warp thereof aligned longitudinally with the principal axis of each of the tubular legs 10.1, 10.2, and 10.3. This gives the tubes a high resistance to bending.

If it is desired to permit curvature of the tubes, the polyester reinforcing fabric may be arranged on the bias to a greater or lesser degree, depending on the curvature that will be permitted.

The airtight fabric is double welded along the length of each tube. In practice, the fabric is welded along axially extending seams with a separate strip of fabric welded internally along each of the seams to provide enhanced sealing.

The tubes making up the legs 10.1, 30.2, 10.3 are interconnected across a joint 12 through which the pressurising fluid can flow freely during inflation and deflation of the structural element 10.

The structural element 10 is inflated and deflated by means of an inflation valve (illustrated diagrammatically at 14).

The most convenient pressurising fluid would be compressed air obtained from a blower or compressor, or from a pressurised gas canister, but alternative pressurising fluids such as motor vehicle exhaust gas could also be used, provided the appropriate inflation fittings are used.

The structural element 10 of the invention can be combined into relatively complex structures that, because of the tetrahedral shape of the unit 10, will have the characteristics of geodesic domes.

The simple structure 100 illustrated in Figures 2 and 3 provides an example of the structure building capabilities of the basic structural element 10.

In the structure 100, four of the units 10 are interconnected to form a four-sided structural frame.

The apical legs 10.3 of the units 10 are connected to one another at the apex 102 of the structure 100 by means of connectors that will be described below.

The support legs 10.3, 10,2 of the structural elements 10 extend down to the ground and are connected to one another by means of connectors that will be described below.

The structure 100 may now be clad with a fabric cover (not shown).

Once the structure 100 is clad with a fabric cover and fastened to a groundsheet, it is completely free standing and needs no pegs or anchor ropes to keep it stable. Very little experience or knowledge is now required to pitch the tent. The energy that pitches the tent is supplied by the compressed gas and the whole prosess is done in a fraction of the normal time.There is also no assembly needed to pitch the tent. The unit only needs to be unfolded and inflated to pitch the tent. The same applies when putting the tent down. The valves in the tubes are opened to let the compressed gas out and the whole structure collapses. It is then folded as a unit in the normal way. There is thus no poles or other structural elements to account for.

The structure 100 provides a high degree of wind resistance but, if required, the structure can be pegged to the ground.

The structure 100 is preferably erected using four separate structural elements 10 that are connected to one another. However, it is also possible to construct the frame of the structure 100 in such a way that the structural elements 10 are not discrete, but rather interconnected at the apex 102 and at the vertices where the leg ends intersect 103.

Figure 4 illustrates two of the metal connectors 15 that are used to interconnect the structural element ends 10.4 of the structural elements 10 (the free ends of the legs 10.1, 10.2 and 10.3 of the structural elements 10). The ends 10.4 of the structural elements 10 are shaped complementary to permit interconnection of the structural elements along the axial angle of the completed structure. Each such leg end 10.4 is finished off with a flat end weld 13 that is double welded and inserted between the flat strips of metal making up the connectors 15.

Each structural element 10 is provided, at its leg ends 10.4 with a connector 15 that comprises a slider 16 and track formation 18, the slider 16 being adapted to slide into the track 18 of an adjacent connector 15. The slider and track formations 16, 18 are dimensioned to provide a secure friction fit once interconnected.

The utilisation of the connector 15 on each tube end has the advantage that two or more tube ends can be interconnected in a very strong and stable bond alleviating the need for a complex welded joint.

The entire connector 15 is riveted together with blind rivets. This has the advantage that the connector formations 16, 18 can be removed to permit reopening of the tube ends and the servicing of the tubes.

In certain situations it might be appropriate to insert a gasket within the sealing arrangement constituted by the connector 1 5 and the welded end of the tube in order to enhance the sealing effect.

The structure 100 illustrated in Figures 2 and 3 are a relatively simple structure that utilises only the basic structural element 10 illustrated in Figure 1. However, the basic structural unit 10 can be used in conjunction with similar yet slightly more complex structural elements to provide more complex structures as is illustrated in Figures 6, 7 and 8.

The structure 200 shown in these drawings utilises two of the basic structural elements 10 at each of its short ends.

In the structure 200 the basic structural elements 10 are each flanked by a slightly modified structural element 202, each of which differs from the basic structural element 10 only in the fact that it has an asymmetrical tetrahedral shape.

The apex and long sides of the structure 200 are defined by a pair of opposed structural elements 204, each of which incorporates a pair of support legs 204.1 and a pair of apical legs 204.2 that extend upwardly towards an apical beam 206 that defines the apex of the structure 200.

The structures of the invention, being inflatable, lend themselves to novel uses. For instance, the structure could be internally lit using light fittings 20 fitted to the insides of the tubes making up the structural elements. In this kind of an application, the fabric of the tubes and the structure as a whole will be chosen for translucency to enhance the lighting effect.

In addition, the structures need not be confined to land. Being inflatable, the structures will float on water to provide a novel staging facility for events and advertising.

Claims

Claim 1

According to this invention an inflatable structural unit comprises at least three inflatable tubes arranged in the form of a polyhedron. The inflatable tubes are airtight and once it is filled with compressed gas to the desired pressure and sealed off, will maintain its rigidity and support strength without any further addition of compressed air.

In its simplest form, the structural unitAeneid comprises three inflatable tubes arranged in the form of a tetrahedron. In this arrangement, the three tubes are co-extensive with three edges of an imaginary tetrahedron.

In this form of the invention, the structural element comprises three legs that radiate from a point of interconnection to define an inverted, Y-shaped element, the arms of the Y constituting support legs and the stem of the Y being angled relatively to the legs to complete the tetrahedral shape of the support unit and defining an apical leg that, in use in a structure will constitute a support beam.

The inflatable tubes used in the support unit may be adapted to extend substantially straight under inflation pressure to obtain a conventional, straight-sided tetrahedron.

Being polyhedral, the structural element of the invention will yield, in combination with similar structural elements, a variety of geodesic structures. In such structures, the apical legs of the structural elements may be secured to the apical legs of adjacent, similar structural elements. In the same way the support legs of the structural elements may be secured to the support legs of adjacent, similar structural elements.

The tube ends of each structural element is geometrically shaped along the natural complimentary lines along the intersecting surfaces of the adjacent structural element. The connectors are fixed along their relative axial angles at the vertex of the polyhedron.

Claim 2

Being inflatable, the structures will float on water to provide a novel staging facility for events and advertising.

Claim 3

The structures of the invention, being inflatable, could be internally lit using light fittings fitted to the insides of the tubes making up the structural elements. In this kind of an application, the fabric of the tubes and the structure as a whole will be chosen for translucency to enhance the lighting effect.

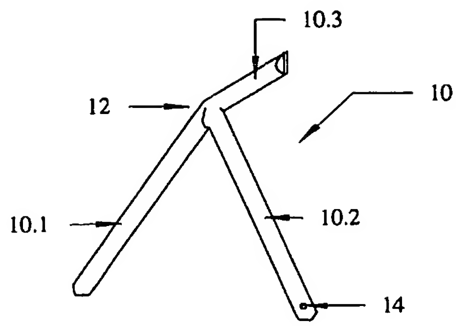

FIG 1

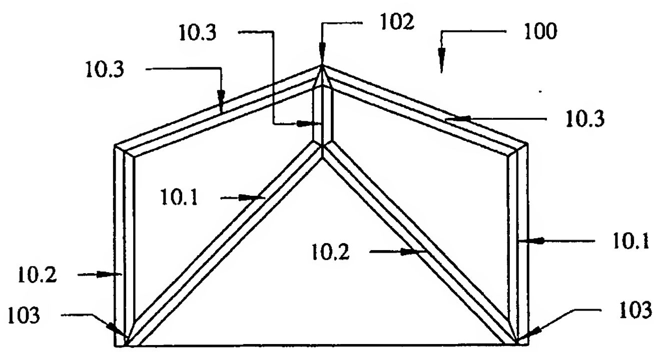

FIG 2

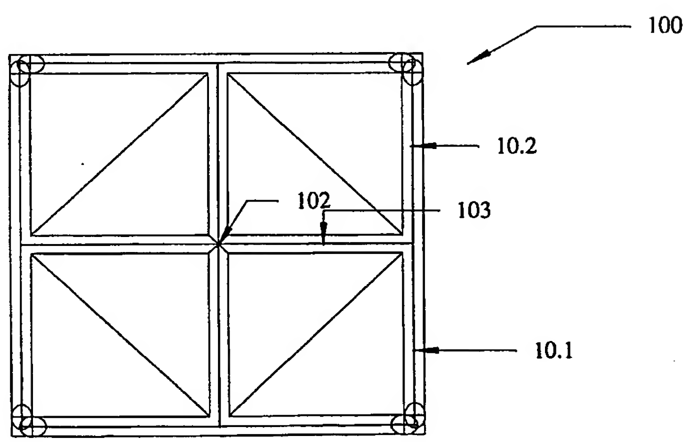

FIG 3

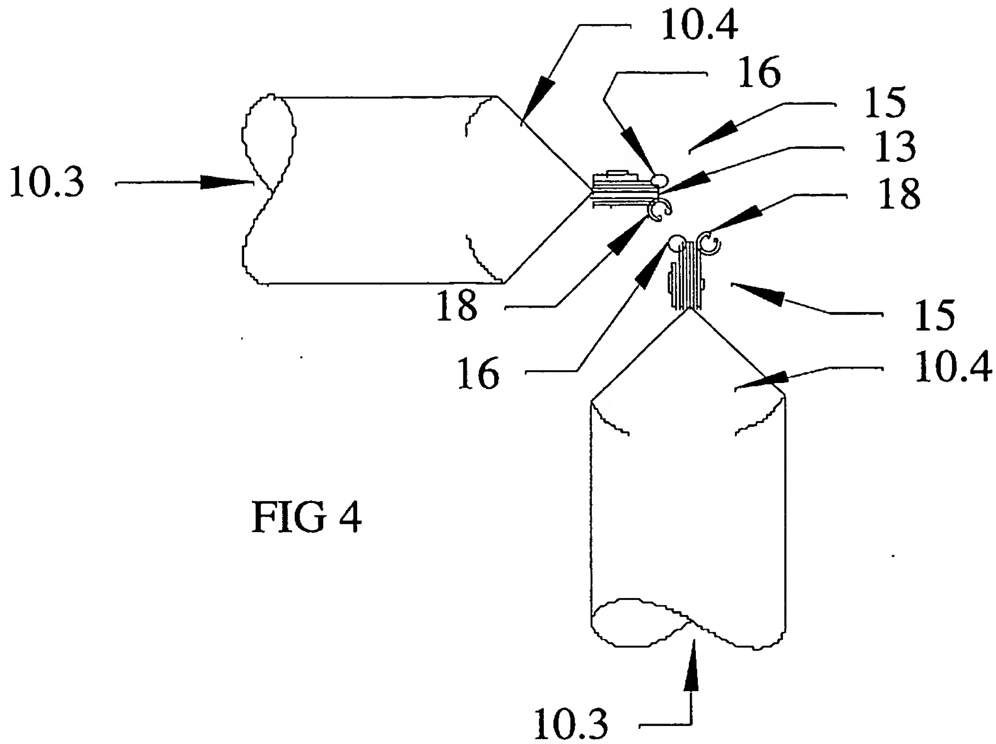

FIG 4

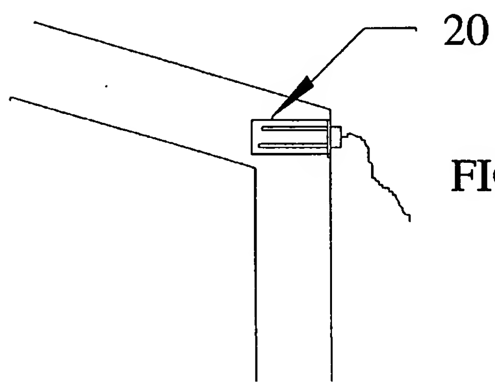

FIG 5

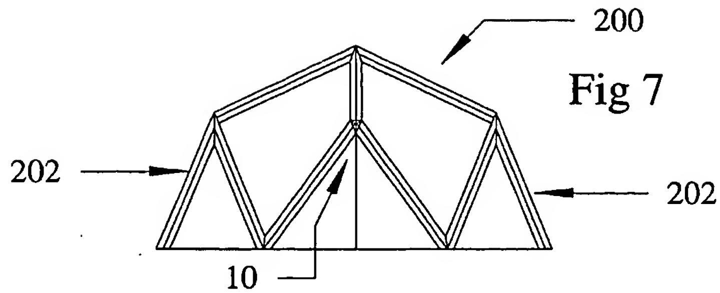

Fig 7

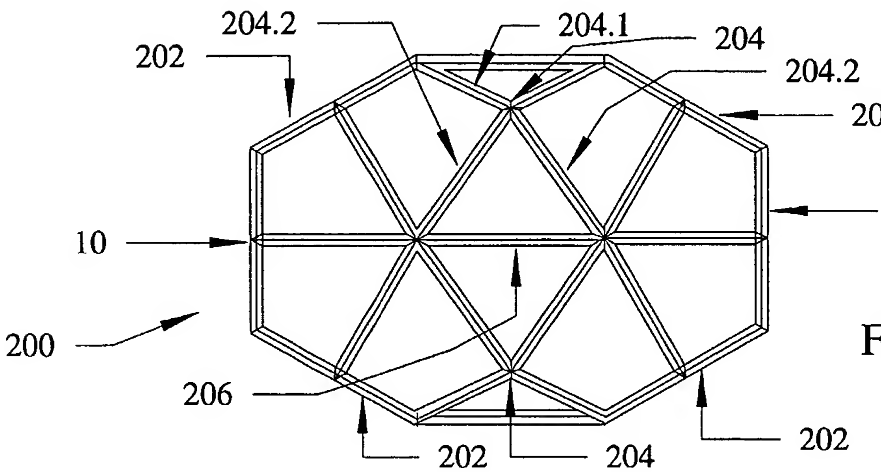

Fig 6

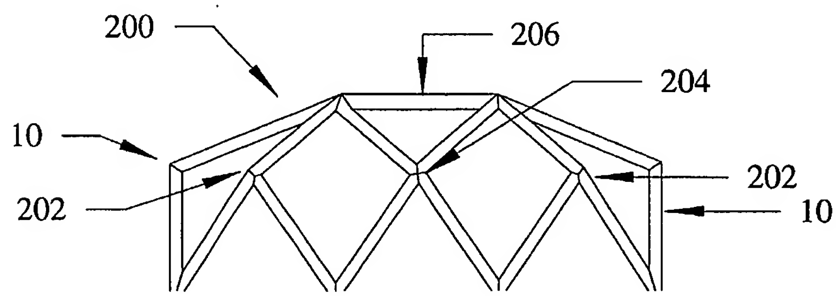

Fig 8

INTERNATIONAL SEARCH REPORT

Inte⁻⁻ınal Application No
PC⌐7ZA 01/00175

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04H15/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 697 045 A (SEMMEL ALAIN) 22 April 1994 (1994-04-22) page 2, line 26 -page 4, line 6; figures 1-4,7 ---	1
Y	US 3 502 091 A (CORBIN JOHN R) 24 March 1970 (1970-03-24) column 2, line 62 -column 3, line 9; figure 1 ---	1
A	GB 2 090 622 A (WILLIAMS MERVYN ELLIS) 14 July 1982 (1982-07-14) page 1, line 91 - line 111 page 2, line 49 - line 53; figures 2,3,6 ---	1
A	US 2 938 526 A (SHRIVER HENRY V ET AL) 31 May 1960 (1960-05-31) the whole document --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2002	28/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Porwoll, H

INTERNATIONAL SEARCH REPORT

Inte   nal Application No
PCT/ZA 01/00175

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 932 169 A (CHARBONNEAU ROBERT) 12 June 1990 (1990-06-12) column 7, line 53 - line 62; figures 1,2 ---	2
A	US 4 120 024 A (AIZENBERG JULIAN BORISOVICH ET AL) 10 October 1978 (1978-10-10) the whole document ---	2
A	US 4 723 382 A (LALVANI HARESH) 9 February 1988 (1988-02-09) -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte[illegible]onal Application No
PCT/ZA 01/00175

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2697045	A	22-04-1994	FR	2697045 A1	22-04-1994
US 3502091	A	24-03-1970	NONE		
GB 2090622	A	14-07-1982	NONE		
US 2938526	A	31-05-1960	NONE		
US 4932169	A	12-06-1990	NONE		
US 4120024	A	10-10-1978	NONE		
US 4723382	A	09-02-1988	NONE		